How this investigation fits within the “Concept and Lesson Map”:

**Overview for Unit 3: Bits and Pieces**

Particles of solid materials can pour like liquids, but unlike liquids they maintain their shape.

Overarching question(s) for this whole investigation:

* How are small solids like liquids and how are they different?

**Attending to “How People Learn”**

How People Learn Key Finding #1: Preconceptions

Eliciting Student Ideas:

* Use the Formative Assessment Probe “Bits and Pieces.” As students finish, question them to learn more about their intentions while drawing (in case the actual efforts didn’t match their intentions!) When the Investigation is complete, students will complete this probe again and compare their two responses, looking for changes in their thinking and trying to determine what events brought about those changes.

Common Student Preconceptions:

* Anything that can be “poured” is a liquid (Driver 2002)
* Something is only solid if it is hard (not soft or crumbly) (Driver 2002)
* Solidity is associated with hardness, strength and non-malleability (Driver 2002)
* Conversion of a bulk solid into a powdered solid or to a liquid is likely to result in a decrease in mass (Driver 2002)
* Any rigid material is a solid, any powder is a liquid, and non-rigid materials (sponge, cloth) are intermediate between a solid and a liquid. (Driver 2002)

How People Learn Key Finding #2: Facts/Concepts/Knowledge

WA State Content Standards “Science Domains” (EALR 4)

* K-1 PS2A Liquids take the shape of the part of the container they occupy.
* K-1 PS2B Solids retain their shape regardless of the container they are in.

WA State Science Standards “Crosscutting Concepts and Abilities” (EALRs 1-3)

* K-1 SYSB Some objects can easily be taken apart and put back together again while other objects cannot be taken apart without damaging them (e.g. books, pencils, plants, and animals).
* K-1 INQA Scientific investigations involve asking and trying to answer a question about the natural world by making and recording observations.
* K-1 INQC Scientists develop explanations, using recorded observations (evidence.)
* K-1 INQF All scientific observations must be reported honestly and accurately
* K-1 APPA Common tools can be used to solve problems
* K-1 APPC A problem may have more than one acceptable solution.

Key Understandings For the Teacher:

* See ***Background for the Teacher*** Inv. 3, p. 4.
* Every substance can exist in a variety of different states, depending on temperature and pressure. When matter gets cold enough, atoms or molecules lock in place in a more or less orderly fashion as solids. (SFAA 1990)
* Solids are materials that have a more or less fixed shape. (Science Matters 1991)

How People Learn Key Finding #3: Metacognition

Metacognition: How did my thinking change? What caused the change? How did I come to believe this?

After completing Investigation 3, students should complete the “Bits and Pieces” assessment probe again, then review their initial ideas from the beginning of the investigation and reflect on how their ideas have changed. Students will need support for this kind of thinking, explicitly connecting back to their preconceptions and what events may have brought about those changes.

* Example: “Look back at your paper where you drew what the things would look like when they spilled. Do you still agree with what you drew, or do you need to show how your thinking has changed after we looked at small solids together?”

**Suggested Assessments for Student Understanding:**

* Throughout the investigation, continue to check with students on an informal, individual basis to see if they are understanding that a solid can have some properties of a liquid (pouring), but still remain a solid.

**Additional Information**

Materials and Student Management

* When science is being conducted at a station and a parent or other helper is monitoring the activity, be sure they are clear about the *purpose* of the station; not just the steps to take the children through. It will help them view the station as a learning experience, rather than an activity to be completed. (When at all possible, the classroom teacher should be leading the stations.)
* **We never taste in science. (Even when our materials are food!)**
* When using food for something other than feeding people, consider your population and be sensitive to the fact that many of these foods are important cultural staples to many people. In addition, be aware that you are using food that could be feeding people...re-use what you can rather than treating them as “consumable materials” or consider putting together a bead mixture that could be re-used in its stead.
* Hand lenses (magnifiers) should be made available to students as they explore small solids, and a microscope if possible.
* Part 1:If possible, keep this center available for students to explore at an appropriate time.
* Part 2: It can be difficult to get the lima beans into and out of the small bottle openings.
* Part 2: In step 8, FOSS suggests ways to encourage students to use the screens. (They will do as much separation as possible manually.) Instead of suggesting students use the screens with questions about the purpose of the screens, try restating the problem they are supposed to be solving (e.g. “We still need to separate the rice from the cornmeal, has anyone figured out how they could do that?” or “We still need to separate the rice from the cornmeal, has anyone found a tool that could help them do that faster?”) This keeps the investigation focused on solving a problem, not using tools just because the teacher put them out. Students who are confident they could sort it by hand may need you to suggest things that would make that impossible (e.g. “How would you separate this mix if there was baby powder in it?” or “Well, we don’t have a lot of time left; is there a faster way we could separate the rice from the cornmeal?”) In addition, if they have found an alternative method that is efficient, they don’t *need* the screens.
* Part 3: If possible, keep this center available for students to explore at an appropriate time.
* Several bottles of homogeneous solids should be created by students for observations. However, FOSS tells you to not let students create mixtures in the bottles...is there a reason they shouldn’t?
* Part 4: This is optional. Students have already completed the activity “Separating Soup Mix” which has the same focus, and the use of concrete manipulatives is far more age-appropriate than the use of the representational materials in this part. If you would like to conduct this activity, consider creating a bead mix students could actually separate with the screens (providing more experience with the same focus as part 2.)
* After final activity of the Investigation,FOSS suggests reading the Science Stories *Solids to liquids and back again.* This is the only place in this unit (aside from the on-line activity on FOSSweb) that deals with changing states of matter. The content is examined in the 3rd grade, *Water* kit, where it better matches State and National standards. (And is presented in a more appropriate format.)
* Extension Activity: If students were engaged by part 3, consider using empty water bottles to make “I-Spy” bottles: Fill the bottle most of the way with one kind of small solid (more filler makes a more challenging bottle), and add small objects like buttons, pennies, paperclips, erasers, etc. Glue the lid on and let students tip and shake the bottles as they look for the objects. Create bottles with different small solids as filler and have the discussion about which makes the most challenging bottle, which is the least and why they think so.
* The Interdisciplinary Extension: *Separate mixtures with magnets or sifters* offers other approaches to separate some materials from others. *Investigate fine powders* is another extension that provides additional opportunities for students to explore even smaller solids.